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The Origin and Development of the Earth.

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Geology is the science which treats of the materials, the constitution, and the development of the earth. The history of the events which have brought this planet and its inhabitants to their present state of being forms one of the principal divisions of the science. Of necessity such a history had a beginning, and concerning this beginning men have ever been prone to speculate. At first these speculations were the mere superstitions contrived in the minds of untutored savages, and we may find many of them in the mythology of the Indians of our own country. Later, in the beginnings of civilization, the philosophers of their time advanced ideas—less erratic and superstitious, perhaps, but hardly less impossible of truth than those of their savage ancestors. But gradually things changed. The invention of the telescope and the study of physics taught man much. Speculation and guesswork slowly gave way before scientific investigation, and within the last few decades there has been a more or less organized effort on the part of the world's greatest scientists to put to use the combined resources of chemistry, astronomy, physics, and geology in order to find a solution for the problem before them. That their efforts have not been without success may be seen when the various hypotheses in which they have resulted are considered.

Some suggestions as to the birth of our planet may be found in a study of its relations to the other bodies of the solar system, and in its characteristics as a member of that system. We may feel quite certain in saying that no such

complicated organization as that which is displayed by the sun and its attendant bodies ever came into existence by accident. Beyond possibility of question the story of the birth of the system would be revealed in its organization and forces, were man only able to read that record. But in spite of the fact that we can give no positive definite interpretation of the remaining traces of the earth's beginning it is necessary, in order to carry on investigation, to form hypotheses to explain them. It is also important that we study these hypotheses carefully and note the various ways in which they may enter into the doctrines and ideas of modern science. Not a few of the principles of geology, astronomy, and even biology rest upon some hypothesis of the earth's origin, and have no greater strength than that of the hypotheses on which they are founded.

1.—The Laplachian Hypothesis.

It is the almost universal opinion among astronomers that the solar system was evolved from some sort of a nebula. Until comparatively recently most of them accepted a special hypothesis advanced in the latter part of the eighteenth century by the great French mathematician Laplace. So general was the acceptance of Laplace's idea that it came to be known as the "Nebular Hypothesis," without consideration of the fact that there were several other hypotheses which also supposed that the solar system was derived from a nebula. This explanation of Laplace's was supposed to offer a thoroughly satisfactory interpretation of the existing evidence as to the origin of the solar system, and therefore of the earth. But with the advance of geological and astronomical knowledge it became evident that the Laplacian hypothesis did not satisfactorily explain the origin of the earth, and that a new interpretation was necessary.

The Laplacian, or as it is popularly called, the Nebular Hypothsis has, however, gained so firm a foothold in literature and general knowledge that we must give it a careful survey before passing on to newer and more satisfactory ideas. Laplace supposed that the solar system was descended from an immense, rotating ball of gas which extended beyond the orbit of the outermost planet—that is, which had a diameter

of more than 5,600,000,000 miles. This ball of gas, which supposedly contained all of the material in the solar system today, possessed at its beginning a very high temperature which it immediately began to lose, just as any hot object will lose its heat. This loss of heat caused shrinkage of the mass, and therefore increased rapidity of rotation. In the course of this rotation great rings of gas, one ring for each of the planets, were left by the contracting central mass. These rings, it is supposed, resembled those about the planet Saturn—in fact it is quite probable that the Saturnian rings suggested this part of the hypothesis. The rings in turn broke up, formed spheres, and in time gave off smaller rings to become the satellites.

According to this interpretation, the earth was originally a globe of very hot vapor which in the course of time cooled, contracted, and gave off a ring which went through the same process and became the moon. The parent mass continued to cool and shrink until it became liquid, and finally formed a crust over its outer surface, the interior still remaining very hot. At this early stage of the earth's history the atmosphere contained all of the gases which now compose it, great quantities of gases that are now united with other elements as parts of the rocks, and all of the hydrogen and oxgen that are now in the waters of the planet. When the cooling process had gone on for so long that gases formerly in the atmosphere could stay in the earth, and those falling as water could remain upon it instead of passing back as vapor, the ancestors of our present oceans began to form.

The hypothesis is skilfully devised, and carefully worked out in many of its details. But in many respects it contains glaring anomalies, and many of the conditions on which it depends could never have existed. In the first place, let us consider the supposed parent nebula a little more closely. The total amount of matter which it contained is now in the solar system—no more, no less. Its diameter was, of necessity, at least 5,600,000,000 miles, and the original hypothesis calls for an even greater figure. Dr. Moulton, of the University of Chicago, has computed that in such a nebula the density would be only one two-hundred-forty millionth of that of air at sea-level—thousands of times more rarified than the most

perfect vacuum that man has been able to produce. How such a nebula, too thin to be perceived by any of our instruments, could have held itself together, and could have retained its heat for any length of time is impossible to understand. Likewise it is impossible that such a nebula should have given off a single ring, even at its earliest stages, or how such a ring, had it been formed, could have condensed into a sphere that could in time become a planet. As well ask the ring of smoke blown from your cigar or pipe to become a ball.

There are also movements of certain of the planets and their satellites that argue strongly against the Laplacian idea. If satellites evolved from rings that come from rotating planets, they should revolve around those planets in the same directation and with the same speed that the planets themselves turn upon their axes. Now the inner satellite of Mars revolves about the planet three times while Mars turns on its axis once, and the ninth satellite of Saturn has been shown to move in a direction opposite to the one in which the planet itself turns. Under the Laplacian hypothesis these things could not be, yet they unquestionably have been observed.

There is, however, one other line of argument which would dispose of the "nebular" hypothesis even though there were no other points against it. The moment, or amount, of momentum of any freely rotating system such as that to which our earth belongs must forever remain constant; that is a well-established principle of physics. In any ancestor of our solar system the moment of momentum must have equaled that of the present system, for the matter composing the one composes the other. But we find that such a nebula as the one postulated by Laplace could not have thrown off a ring until it had shrunk far within the orbit of the innermost planet. In order for this nebula to have produced the supposed ring from which Neptune was to descend it must have possessed at at least 200 times the momentum that is in the solar system today. *And yet the moment of momentum of any freely rotating system must forever remain constant.*

Or let us consider matters from another angle. If the Laplacian hypothesis were correct, the amount of momentum which a planetary ring could possess should be directly proportional to the amount of material in that ring; the greater

the ring, the greater the moment of momentum. Now the mass of material composing the ring from which Jupiter and his suns supposedly descended was about one one-thousandth part of that of the parent nebula at that particular stage of its development, but these same planet and satellites contain 95 percent of the solar nebula at that stage. Equally striking discrepancies appear when the momentum of the other planets is considered. In other words, the Laplacian hypothesis seems to demand that the solar system be so organized that the planets and satellites, amounting to about one seven-hundredth of the total mass of the system, were able to carry off more than 97 percent of its total momentum. *There is no law of physics or astronomy that will allow for such a condition.*

So far, the arguments against the nebular hypothesis which we have considered have been principally astronomical, and credit for their discovery and elaboration must be given to Dr. F. R. Moulton, the first astronomer to seriously consider the difficulties in the way of Laplaceism. There are other arguments, perhaps equally strong, coming from the geologists and paleontologists, but these will be left for consideration farther on in the paper. On the whole, the Laplacian hypothesis must be given up. The idea of a molten globe which is gradually cooling and losing its atmosphere; of the moon as a dead body, and the earth and Mars as dying ones is very poetic but it fails to stand the test of modern science. Writers of feature articles for Sunday papers, and of "popular" books on alleged science still favor the old idea, for it works up excellently into sensational treatment. We must, however, as did geologists and astronomers of thirty years ago, look for another solution.

2.—The Meteoritic Hypotheses.

No matter how great the popularity of any hypothesis there are bound to be people who will disagree with it and advance other ideas, and the Laplacian hypothesis was no exception to this rule. Hundreds, even thousands of years before Laplace's time it had been noted that "shooting stars" enter the atmosphere in great numbers, and that occasionally fragments of stony or metallic material fall to the earth. From the ob-

servation of these meteors and meteorites arose the idea that the earth had been built up from them, the rate of infall being more rapid in the early history of the process. The great irregularity in the motions and velocities of the observed meteorites soon shows that this explanation fails to account for the development of any such orderly and harmonious motions as are to be seen in the solar system.

George Darwin, a son of the great Charles Darwin, still thought he saw in the infall of meteors and meteorites a possible solution of the origin of the solar system. He believed that meteorites might be brought together into swarms, thus constituting nebulae. These nebulae would, according to Darwin, behave essentially as though they were composed of gases, and the laws of gases might be used in determining their mechanics. If this were the case, the same objections which have been raised against the Laplacian hypothesis apply to the one sponsored by Darwin and Lockyer, so it need not be given further attention.

3.—The Planetesimal Hypothesis.

When the failings of the Laplacian hypothesis became so evident, and the hypothesis of Lockyer and Darwin showed itself to be unreliable—in fact, less satisfactory than that of Laplace—an alternative more suited to the facts was looked for. Earlier astronomers and astrophysicists had maintained that the matter of a nebula, if composed of particles revolving around their common center of gravity, could not come together into planets without giving them a backward motion. The six inner planets of the solar system have forward rotations, and for the time being all hypothesis of the *strictly* nebula type seemed to be ruled out. A more careful survey, by Doctors Moulton and Chamberlin, showed that this conclusion was wrong, and that there was no initial barrier in the way of a hypothesis in which the solar system was supposed to be descended from a nebula. It was also shown by astronomic photography that there were many times the number of nebulae that there formerly were thought to be, and it was to these that Dr. Chamberlin turned his attention.

The nebulae known at the present time seem to fall into two classes, when studied with the spectroscope. The first

class is characterized by bright spectral lines which indicate a structure somewhat akin to gaseous, although it is not certain that this is the actual condition. Due to the fact that these nebulae show the presence of some elements not known to exist in any part of the solar system, and since there is absolutely no indication of metals in their constitution, they have been ruled out. It is, of course, conceivable that the elements composing these nebulae might in the course of time become elements such as we know, but is mere supposition, and will not suffice as a ground for basing a hypothesis.

The other class of nebulae give what are called "continous line" spectra, which is commonly interpreted to mean that the materials composing them are in either liquid or solid state. It is also almost certain that these nebular materials are in very finely divided particles, for in spite of the immense size of the nebulae they are known to intercept very little light and possess but slight gravitative power. Their spectra show, it seems, the presence of the same elements that compose the solar system, and their number is at least ten times as great as that of the nebulae of the "bright line" type.

The dominant type of these nebulae is the *spiral,* as was determined by the great astronomer Keeler, for years the director of the Lick Observatory. The distinguishing characteristic of the spiral nebulae is a central mass or ball with two arms which arise from opposite sides of the central mass and curve concentrically away from it. In the outer regions of these arms they commonly branch, but throughout all of the spiral nebulae the two dominant arms may be distinguished. In these nebular arms there are also considerable knots between which the nebulous matter is irregularly distributed. It is clear, from oblique views of the nebulae, such as that of Andromeda pictured in the accompanying plate, that the spirals are roughly disk-like, a shape which corresponds with that of the solar system.

The results of their study of the various characteristics of the spiral nebulae convinced Chamberlin and his associates that here, if anywhere among the astronomical bodies, they might successfully look for the traces of the earliest history of the solar system. While nothing is as yet known of the motions of the parts of these spirals, their shape seems to

indicate that they are the products of combined outward and rotatory movement. The former is indicated by the protuberance of the arms, the latter by their pronounced coiling. Such a supposition calls for the existence of an earlier body that embraced the whole mass, and from which the present nebula is descended. We are forced to look, not only for the ancestor of the solar system, but for the ancestor to that ancestor. Such exploration must, of course, possess a good deal of uncertainty, and its results must be taken, as the saying is, with a grain of salt. Nevertheless, where there are thousands of known cases similar to that under consideration—i. e., the spiral nebula—and in all of these cases the same results are evident, it is not out of the way to suppose that the same causes apply throughout. What the scientist must do in such a case is to determine what conditions might produce the results observed, and take the most satisfactory of the hypotheses as the one on which to base his further work.

This is precisely what Professor Chamberlin did. The body most apt to produce a nebula of any sort is a sun, and of these there are more than 100,000,000 known, besides an unknown multitude of dark bodies which move through space, and of whose existence we have no definite knowledge. Among such a throng of celestial bodies it is almost inevitable that collisions should have occurred during the billions of years which the universe has been in existence. These collisions would naturally occur in the regions where stars are thickest, and it is worthy of note that in such a region, the Milky Way, the number of new stars—stars which appear where none were before—and also the number of bright line or free-molecular nebulae, are the greatest. This does not mean that the new stars and the bright line nebulae necessarily arise from the collision of two celestial bodies, but it does give weight to the statement that such collisions occur.

If collisions between stars occur, as it is almost certain they do, there must be much greater probability of close approach of the stars to one another or to dark bodies. There are several astronomical considerations which make it probable that close approach rather than actual collision is responsible for the origin of the spiral nebulae, and it was therefore selected by Chamberlin. It must be remembered, however,

that the planetesimal hypothesis, as the proposed explanation of Chamberlin and Moulton is called, does not rely upon any set origin of the spiral nebulae; it merely proposes an origin for them. Its true basis is the existence of the spirals, which is unquestioned.

Our present sun shoots out great protruberances to the heights of many thousands of miles at velocities which, were it not for the great weight of the sun's atmosphere, would carry them to the outer limits of the solar system, or perhaps even beyond it. Let us now suppose that another sun were to approach ours. The attraction between the two, due to gravity, would greatly increase the tension upon the sun, and would thus cause great tidal protuberances to arise. These protruberances, were the forces causing them great enough, might well leave the sun, never to return. Of such material, arising much as in the manner briefly outlined above, the planets and satellites are supposed to be composed.

We have said that the forms of the spiral nebulae seem to imply that they originated through two types of movement—outward, and rotatory. The outward movement we have just accounted for in the projection of the protruberances from the parent sun through the attraction of another sun passing relatively near it. It now remains for us to account for the rotatory motion.

The protuberances would, according to this hypothesis, be thrust out as the ancestral sun and the passing star were swinging about their common center of gravity. The protuberance shot from the sun in the direction of the star would be drawn into a curved path by the attraction of the star, and the same would be true of the opposite projection, but to a lesser extent. The accompanying diagram, taken from Moulton shows how this would develop a spiral from the partially disrupted sun. Since in the course of rotation the inner parts of the spiral moved more rapidly than the outer, just as the small hand of a clock rotates more rapidly than the large, the arms became more closely coiled, finally developing a closely coiled spiral probably somewhat similar to the accompanying restoration. Since the parent sun was gaseous, as it is today, the particles composing the arms must have originally been in a free molecular state. Their enormous

dispersion, with corresponding opportunity for cooling would soon make of them liquid or solid particles revolving about the sun as their common center of gravity. These particles were the originals of the planetesimals, or as the word means, "little planets."

We now have the spiral nebula, ready for the final development into the solar system. In it are five elements which are to perform the leading parts in the evolution of a planetary system from the spiral. They are:

1. The great central mass (to become the sun.)
2. The main knots in the arms (to become the planets.)
3. Minor arm knots near the large knots, and more or less controlled by them (to become nuclei for the satellites.)
4. Small, scattered knots (to become nuclei of the asteroids.)
5. Scattered nebulous matter (to be added to the nuclei or sun.)

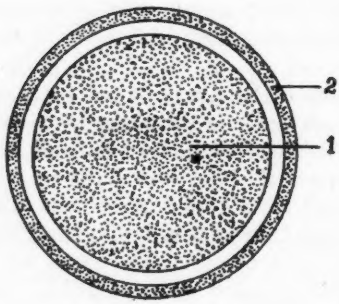
It is assumed that in the early spiral nebula the small particles, or planetesimals, possessed elliptical orbits, as do the bodies of the solar system at the present time. All of these orbits would have as their gravitative center the sun, as would also the orbits of the nuclei. In the course of their passages through space the various bodies, both nuclei and planetesimals, would either pass near to each other or collide and as a result the small particles would be drawn to the larger particles, and these in turn to the nuclei. We thus have the nuclei, or beginnings, of the planets gradually increasing in size by the aquisition of the scattered fine material of the nebula. How long this may have taken—how many thousands of millions of years the growth of a planet occupied—we have no means of telling, but without doubt it was many.

How small the nucleus of the earth was we do not know, just as we do not know how rapidly it was built up. We know that the process has not yet ceased, for every year millions of meteors come within the atmosphere. Most of them become dust before reaching the surface of the earth, but the larger

ones occasionally pass through the atmosphere without being totally destroyed, and reach the earth as meteorites. Obviously the process is now going on much more slowly than it was during the early history of the system, for the larger bodies were undoubtedly acquired early in the growth of the planet.

This conception of the origin of the earth differs, as can be readily seen, from the one proposed by Laplace. According to it the earth, instead of having shrunk from a ball much larger than it now is, has been built up from a mass the smallness of which cannot be determined. The moon, instead of being descended from a ring left behind by the contracting earth, had its origin in much the same manner as did our planet. Since it was never so large as the earth, and is quite near to it, it is controlled by the earth just as the earth is controlled by the sun.

We now come to the question which proved the undoing of the Laplacian hypothesis—that of movement and rotation of the planets and satellites. But according to Chamberlin's hypothesis there would be no fixed relation between the rotation of a planet and the revolution of its satellites. The rotation of either a planet or satellite may be forward, or it may be retrograde. The former would be the rule and the latter the exception, and this is precisely the case with the solar system. There are many other features of the solar system to be fittingly explained by the planetesimal hypothesis. Certain of them possess added weight because they were not discovered until after the hypothesis had been formulated and published. Any hypothesis, if it is to be considered at all, must explain the facts which are known and considered when it is being formulated. But the hypothesis which merits serious study or even acceptance is the one which explains conditions that were unknown to its authors. This the planetesimal hypothesis of Chamberlin and Moulton to do.



A

B

FIGURE 1.

A

Diagram of the supposed earth-moon stage of the Laplacian hypothesis. 1 is the central mass which is to form the earth, and 2 the ring which supposedly condensed into a ball and became the moon.

B

The earth on the Laplacian hypothesis. The heavy black portion represents the supposed solid "crust"; the lined disc represents the "molten interior."

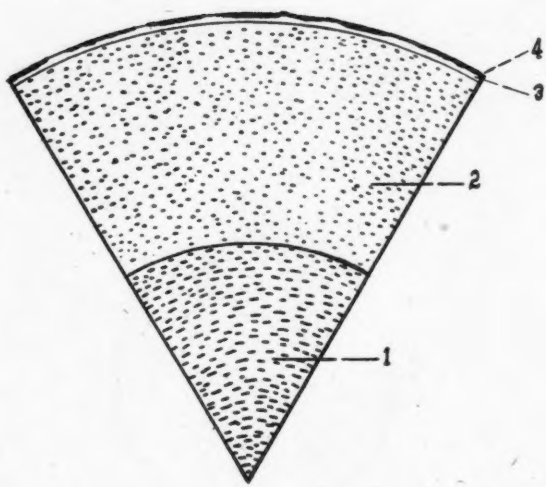


FIGURE 2

A section of the earth on the basis of the Planetesimal Hypothesis (after Chamberlin and Salisbury). The inner division 1, represents original planetesimal matter, with some igneous rocks. The second zone 2, represents the times of earliest sedimentation. Planetesimal matter still dominates, but there is much igneous rock, and some sedimentary rocks, now changed by pressure and other agencies. 3 is a zone rocks, now much changed by pressure and other agencies. 3 is a zone of lavas and other igneous rocks, largely volcanic, with some sedimentary rocks. It represents the deposits of the time when planetesimals became few and small, but the pressure of the growing earth caused much vulcanism. 4 is the newer rocks, mostly sedimentary, representing deposits made from the times of the earliest known abundant fossils to the present.

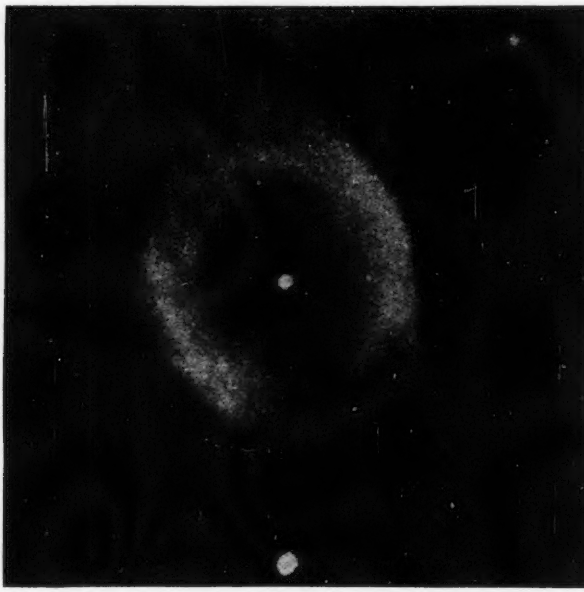


FIGURE 3.

The ring nebula in the constellation Lyra. This nebula seems to be a great vortex of the smoke-ring type, and may be due to the center-to-center collision of two large suns. From Chamberlin. Photographed at the Lick Observatory.

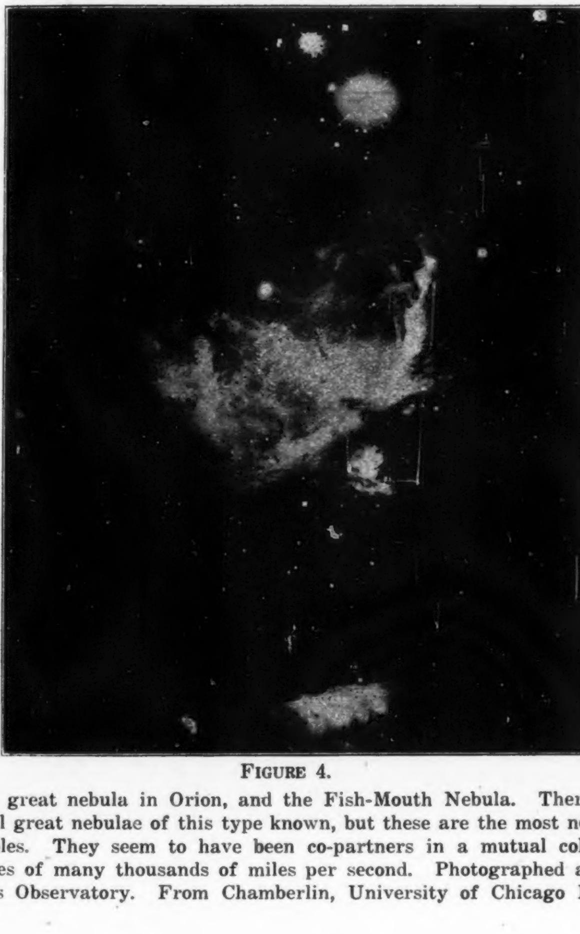


FIGURE 4.

The great nebula in Orion, and the Fish-Mouth Nebula. There are several great nebulae of this type known, but these are the most notable examples. They seem to have been co-partners in a mutual collision at rates of many thousands of miles per second. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

FIGURE 5.

The remarkable spiral nebula, M 51, in the constellation Canum Venaticorum, or the Hunting Dogs. This nebula shows with remarkable clearness the great central mass from which extend two partly coiled arms. In these arms can be seen large knots, which play so important a part in the conception of the Planetesimal Hypothesis. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

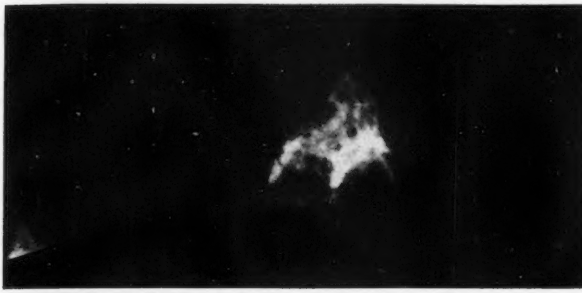


FIGURE 6.

An eruptive prominence of the sun, photographed at Yerkes Observatory on March 25, 1910. This prominence is but one of the many that are constantly being shot forth from the surface of the sun, rising many thousands of miles above its surface, and traveling at a speed of hundreds of miles per second in some cases.

FIGURE 7.

The same prominence shown in Figure 6, photographed 43.2 minutes later. The immense size of the prominence, and the great speed which it possesses may be judged by comparison with the previous figure, and with the curvature of the visible portion of the sun's outline. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

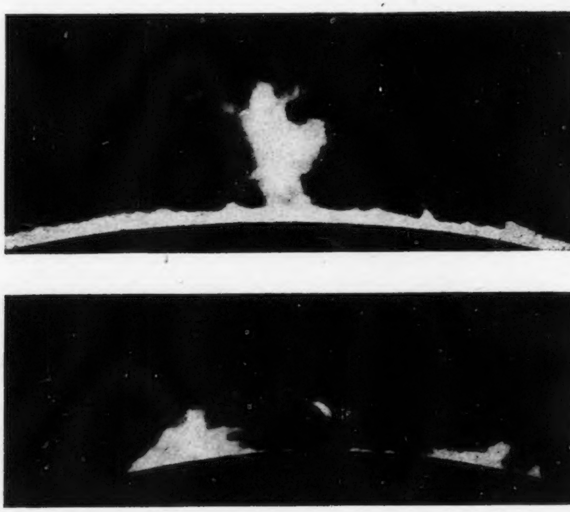


FIGURE 8.

Eruptive prominences of the sun. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

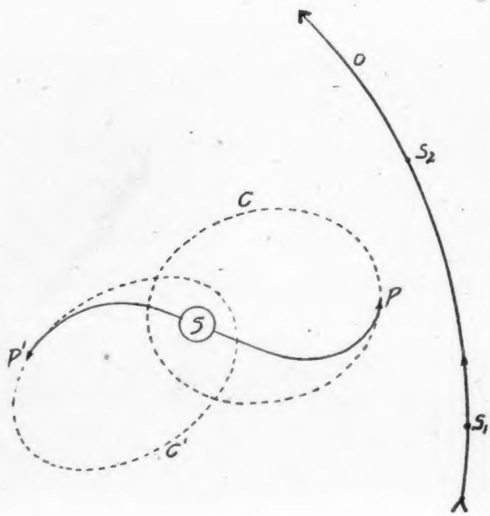


FIGURE 9.

Diagram by F. R. Moulton showing the supposed manner in which orbits and the spiral form of the nebula were formed. S is the ancestral sun of the solar system; the approaching sun passes along the path of the larger curve. When it is at the position S1 it draws a body at P' toward it in the direction of C'. As it passes on to S2 it acts similarly on the particles coming out towards P. The result is a loosely coiled spiral, with the particles composing it revolving around the central mass or sun. From Chamberlin.

FIGURE 10.

A spiral nebula in the constellation Pegasi, in which the arms are remarkably distinct and very slightly coiled. This nebula is very much like the supposed solar system nebula would have been in its early stages, before the arms coiled closely. Compare this nebula with the one shown in Figure 5. From Chamberlin, University of Chicago Press.

FIGURE 11.

An eruptive prominence of the sun in which there is a series of smaller knots projected with the main knot. Under the gravitative pull of a passing sun, such as postulated in the Planetesimal Hypothesis, there would be many such knots as these, but of even greater dimensions. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

FIGURE 12.

An edge view of the spiral nebula HV 24, Comae Berenices, showing that it has a highly discoidal form. The dark band that shows across the central ball is probably caused by light-absorbing matter. The fact that spiral nebula are discoidal in form supports the hypothesis that the solar system, also discoidal, is descended from one of them. Photographed at the Lick Observatory. From Chamberlin, University of Chicago Press.

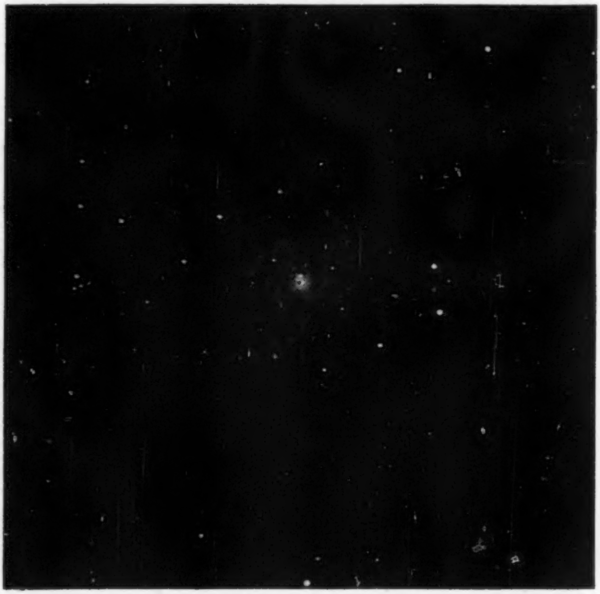


FIGURE 13.

The spiral nebula M 74, in the constellation Piscium. This nebula contains a large central body and two well-defined and closely coiled arms. The arms bear a large series of knots that seem to be highly suited to serve as collecting centers for the nearby, scattered nebulous matter. Photographed at the Lick Observatory. From Chamberlin, University of Chicago Press.

FIGURE 14.

The gigantic nebula M 33, in Triangulum. Even this immense nebula is not too large to have originated in the manner which Dr. Chamberlin assigns for the formation of the spiral nebulae. Photographed at the Yerkes Observatory. From Chamberlin, University of Chicago Press.

4.—Effects of the Planetary Hypothesis on Scientific Ideas.

Such a radical change of thought as that involved in the giving up of the Laplacian hypothesis and the acceptance, either provisionally or otherwise, of the newer ideas of Chamberlin and his co-workers could hardlly fail to affect scientific thought. We used to be taught that the earth was originally intensely hot; that its atmosphere was at the same time very heavy. We were told that the oceans were once composed of hot water, and that life could not exist until they had had time to cool. The atmosphere was said to be steadily decreasing in amount, and the atmosphere moon was held up to us as a horrible example of what the earth would some day come to.

Under the new hypothesis, conditions were very different, and these conditions coincide with the evidences of geology and bilogy. The earth was at one time, during the stage when it was just developing as a planet, too small to hold an atmosphere, just as is the case with the moon at the present time. Gradually the planet increased in size until it became large enough to hold an atmosphere—that is, about as large as the planet Mars. From that time on the earth has been growing, and its atmosphere increasing. When the oceans first formed they were probably no warmer than those of today, and the first life began in conditions essentially the same as those which now exist. Hundreds of millions of years ago there were great glaciers that reached far down into the torrid belt —to within 18 degrees of the equator, and hundreds of millions of years ago there were deserts, just as there are today. The interior of the earth is not inherited from a molten mass, nor is the center of the earth molten at the present time. Volcanoes, instead of springing from a great internal reservoir of molten material are comparatively superficial in their origin. These facts we know from geology and physics. They exist, yet they fit no known hypothesis but the Planetesimal. In closing, however, it will be well to bear in mind that the planetesimal hypothesis is not proved. The difference between a hypothesis and a theory is essentially the difference between perhaps and probably. A hypothesis

that is well enough substantiated may become a theory. To many it seems that the planetesimal hypothesis is receiving this support, but the authors do not yet assign to it the element of certainty that is implied in the use of the word "theory."

There are some statements, however, that may be made with certainty. One of these is that neither the Laplacian hypothesis nor any modification of it, nor any of the hypothesis of the meteoritic group offer anything whatever of a satisfactory interpretation of the origin of the solar system. They have been definitely proved to possess no foundation, and to attempt to use them further, whether in geology or in any other science is futile. On the other hand, the planetesimal hypothesis stands out as the one existing explanation of the earth's origin which has not shown flaws. It is in accord with all known facts ,and as said before, explains some that were unknown at the time it was originally proposed. It affords a reasonable and satisfactory basis for scientific and popular thought, and as such a basis it is of almost inestimable value.

Nomenclatorial Notes on Certain American Plants.—I.

HOMER D. HOUSE.

BOTRYCHIUM ONEIDENSE (Gilbert) House, comb. nov.

This was originally described from Oneida county, New York, as a variety of *Botrychium ternatum* (Fern Bul. (9) 27. 1901), and later (Walters, Ferns p. 334. 1903), transferred to *Botrychium obliquum* as a variety. Additional collections from Albany and Greene counties indicate that it is more properly to be regarded as a distant species.

AGROSTIS PECKII House, nom. nov.

A. caespitosa Torrey, Ann. Lyc. N. Y. (1): 152. 1824. Not Salisb.

Trichodium montanum Torr. Fl. N. & Mid. U. S. (1): 84. 1824. Not *Agrostis montana* R. Br.

A. torreyi Kunth, Enum. (1): 226. 1833.—Tuckerman in Hovey's Mag. Hort. (9): 143. 1943. Not *A. torreyana* Schultes, 1824.

A. laxiflora var. *montana* Tuckerm. Am. Jour. Sci. (45): 43. 1843.

A. laxiflora var. *caespitosa* Torrey, Fl. N. Y. (2): 442. 1843.

A. oreophila (Trinius, misapplied by) Nash, in Britton & Brown,

illus. Fl. Ed. 2, (1): 207. 1913; Robinson & Fernald in Gray, Man. Ed. 7, 1908.

A rather anomalous species, closely related to *Agrostis hyemalis,* possessing awned spikelets, and at higher altitudes with a tendency to form tufts with numerous slender radical leaves. The species as here considered may be regarded as based upon *Agrostis caespitosus* Torrey (1824), who first described it fully. The awn, when present, varies in length and springs from the back of the flowering glume.

In recent floras this has been designated as *A. oreophila Trinius,* but that according to Hitchcock is, as to type specimen, a small erect form of *Agrostis perennans.*

Torrey's type was collected on Mt. Beacon, near Fishkill, and it also occurs on Bald mountain, Herkimer county, *Plaine, Haberer;* Essex county, *Peck,* and Hamilton county, *Peck.*

TRIANTHELLA House, Gen. nom. nov.

Tofieldia, Sect. *Triantha* Nutt. Gen. (1): 235. 1818.
Triantha Baker, Jour. Linn. Soc. (17): 490. 1879. Not *Trianthus* Hook. f. Fl. Antart. (2): 320. 1846.

TRIANTHELLA GLUTINOSA (Michx.) House, comb. nov.

Narthecium glutinosum Michx. Fl. Bor. Am. (1): 210. 1803.
Tofieldia glutinosa Pers. Syn. (1): 399. 1805.
Triantha glutinosa Baker, l. c.

TRIANTHELLA RACEMOSA (Walt.) House, comb. nov.

Melanthium racemosum Walt. Fl. Car. 126. 1788.
Narthecium pubens Michx. Fl. Bor. Am. (1): 209. 1803.
Tofieldia pubens Willd. Ges. Naturf. Fr. Berl. Mag. (2): 28. 1808.
Tofieldia racemosa B. S. P. Prel. Cat. N. Y. 55. 1888.
Triantha racemosa Small, Fl. SE. U. S. 249. 1903.

In this connection it is necessary to consider the generic name *Conradia* or (*Leptilix*) Raf. Neogent. 3. 1825, which reads as follows:

"Diff. Tofieldia; cal. tridentate, cor. six parted, stam. six, base broad, pistil triangular, three short styles and capitate stigmas; one capsule, three angular, three locular, three valve, six seeded. Type all the American species of Tofieldia; the European have three capsules, six petals, etc."

Tofieldia palustris Huds., with a deeply 3-lobed capsule, occurs in Europe and across the subarctic portions of America, a fact probably unknown to Rafinesque, which may ex-

plain his statement that *Conradia* includes all of the American species of *Tofieldia*. No definite type species is indicated, and the statement regarding the stamens having "base broad" applies better to *Tofieldia glabra* Nutt., than to the species of *Triantha* (Nutt.) Baker, and hence the name *Conradia*, doubtless meant by its author to cover this group, must be discarded, or at best considered as a synonym of *Tofieldia*.

POLYGONELLA SEROTINA (Raf.) House, comb. nov.

Polygonum serotinum Raf. Ann. Nat. 12. 1920.

Gonopyrum americanum F. & M. Mem. Acad. St, Petersb. (VI) (4): 144. 1840.

Polygonella ericoides Engelm. & Gray, Bost. Jour. Nat. Hist. (5): 230. 1845.

Polygenella meissneriana Shuttl. ex Meissn. in DC. Prodr. (14): 81. 1856.

Polygonella americanum Small, Torr. Club Mem. (5): 141. 1894.

The description of this species by Rafinesque is clear and sufficiently accurate to quite positively identify it with *P. americanum* (F. & M.) Small. The type locality is given as near Lexington, Kentucky. Rafinesque states that the species will probably belong to the genus *Polygonella* of Michaux, which he has called *Lyonella*. (In this connection it is to be noted that *Lyonia* Raf. Med. Repos. II. (5): 353. 1808, is a mere renaming of *Polygonella* Michaux, and hence rests upon the same type species. *Lyonella* Raf. Am. Mo. Mag. (2): 266. 1818, is also a renaming of Michaux's genus *Polygonella*.

In the second edition of the Flora of the Southeastern United States, Small places *P. articulata* and *P. americana*, in the genus *Gonopyrum* Fisch. & Mey. 1840; and if this segregation of *Polygonella* be maintained, the plant under consideration will be called GONOPYRUM SEROTINUM (Raf.) House, comb. nov.

VITIS LECONTIANA, House, nom. nov.

Vitis bicolor LeConte, Proc. Acad. Phila. (1852-53): 272. 1854. Not *V. bicolor* Raf. Med. Fl. (2): 140. 1820.

From the manner in which "*Vitis bicolor*" is cited in the Index Kewensis, the authors of that index must have assumed that Rafinesque's species was the same in character as well as in name, as that well known species first described by LeConte. An examination of Rafinesque's description, however,

shows that his *V. bicolor* applies to some cultivated variety of *Vitis vinifera* with "berries round, soft, black and white on the same branch," and further, the description is placed in Section II, "Exotic Grape Vines."

Section I of Rafinesque's "monograph," treats of the "North American Grape Vines," and among the many species so inadequately defined, the real *Vitis bicolor* of LeConte, may exist under the names: *V. callosa, V. hyemalis, V. labruscoides* or *V. dimidata,* but it is quite impossible to find anything in the description of these four, which might positively indentify them with *Vitis bicolor* LeConte, here renamed in his honor.

In this connection it should be noted that while most of Rafinesque's names in the genus *Vitis* are impossible of recognition, they nevertheless render several later names invalid, viz:

Vitis farinosa Welw., Not Raf.
Vitis integrifolia Baker, Not Raf.
Vitis montana M. Laws., Not Raf.
Vitis obovata M. Laws., Not Raf.
Vitis obovata Baker, Not Raf.

VITIS SHUTTLEWORTHII, House, nom. nov.

Vitis coriacea Shuttlw., ex C. Koch, Dendrol. (1): 550. Not *V. coriacea* Miq. Ann. Mus. Bot. Ludg. Bat. (1): 78.

Native of peninsular Florida, in sandy soil.

PLUCHEA VISCIDA (Raf.) House, comb. nov.

Gynema viscida Raf. Ann. Nat. 15. 1820.
G. dentata Raf.; DC. Prodr. (5): 452. 1830.
Pluchea petiolata Cass. Dict. Sci. Nat. (42): 2. 1836.
P. foetida DC., l. c.

The description by Rafinesque reads as follows:

"Partly pubescent and clammy; leaves petiolate, elliptical, lanceolate, acuminate at both ends, mucronate, serrate, base entire, flowers corymbose, terminal and axillary, glomerulated; folioles of the perianthe ovate-lanceolate, acute, rufous, ciliolate.—A fine species not uncommon in Kentucky in fields and woods. It belongs to the genus Gynema of my Flora Ludoviciana. Stem two to three feet high. The whole plant has a very strong balsamic smell. It blossoms in August and

September; flowers pale red. I had formerly called it G. dentata. Biennial."

I am unable to find that Rafinesque had made an earlier publication of the name "G. dentata," and I assume that it was a manuscript name, and one evidently transmitted to his European correspondents, as the name seems to make its first appearance in DeCandolle's Prodromus in 1830.

CLINOPODIUM ARKANSANUM (Nutt.) House, comb. nov.

Hedeoma glabra Nutt. Gen. (1): 16. 1818. Not Pers. 1805.
Hedeoma arkansana Nutt. Trans. Am. Phil. Soc. N. S. (5): 186. 1834.
Calamintha nuttallii Benth. in DC. Prodr. (12): 230. 1848.
Rafinesquia angustifolia Raf. New Fl. (3): 51. 1838.
Micromeria glabella var. *angustifolia* Torrey, Fl. N. Y. (2): 67. 1843.
Satureia arkansana Briq. in Engl. & Prantl. Pflanzenfl. (4): Ab. 3, 302. 1896.
S. glabra Fernald, Rhodora (10): 85. 1908.

The range of this little member of the Mint family reaches eastward to New York state, at Niagara Falls.

VIBURNUM ERADIATUM (Oakes) House, comb. nov.

Viburnum pauciflorum Pylaie; Torr. & Gray, Fl. N. Am. (2): 17. 1841. Not Raf. Alsog. Am. 58. 1838.
V. opulus var. *eradiatum* Oakes, in Hovey's Mag. Hort. (7): 183. 1841.

A subalpine species extending into the high mountains of northern New England and New York, and to northern Michigan and Minnesota.

AGALOMA ELLIOTTII House, nom. nov.

Euphorbia gracilis Ell. Bot. S. C. & Ga. (2): 657. 1824. Not Lois. 1807, or Bess. 1816.
Agaloma gracilis Nieuwl. Am. Mid. Nat. (2): 299. 1912.
Tithymalopsis gracilis Small, Fl. SE. U. S. 716. 1903.

Dr. Nieuwland (Am. Mid. Nat. 2: 299) has pointed out the fact that Agaloma Raf. is the correct generic name for the Euphorbiaceous genus heretofore called *Tithymalopsis*. The specific name, however, for this species is invalidated by the publication of two other species both called *Euphorbia gracilis*.

AGALOMA MARYLANDICA (Greene) House, comb. nov.

Euphorbia marylandica Greene, Pittonia (3): 345. 1898.

An anamolous species of very limited range, known only from a few localities in the sandy region between Baltimore

and Washington. It is not improbable that this is the *Euphorbia uniflora*, so inadequately described by Rafinesque (Med. Repos. II (5) : 360. 1808), from the same region.

SOLIDAGO ALLEGHANIENSIS House, nom. nov.

Solidago monticola T. & G.; Chapm. Fl. So. U. S. 209. 1860. Not Jordon, in Bor. Fl. Centr. Fr. Ed. 3, (2) : 324. 1857.

S. curtisii var. *monticola* T. & G. Fl. N. Am. (2) : 200. 1840.

In deep mountain woods from southern Pennsylvania and Maryland to West Virginia and Georgia and Alabama.

SOLIDAGO SALARIA House, nom. nov.

Solidago angustifolia Ell. Bot. S. C. & Ga. (2) : 388. 1824. Not Mill. Gard. Dict. Ed. 8, No. 3, 1768.

In marshes along the coast of the southeastern United States. Apparently also described by Pursh (Fl. 541. 1814) as *Solidago mexicana*, but not the *S. mexicana* of Linnaeus.

FRAGARIA MICHAUXIANA House, nom. nov.

Fragaria canadensis Michx. Fl. Bor. Am. (1) : 299. 1803. Not Crantz, 1766.

F. virginiana Eaton, Man. Ed. 6, 148, in part. 1833. Not Duchesne.

A common species of the northeastern United States. It is possible that the imperfect description of *Fragaria serotina* Rafinesque (Atl. Jour. 152. 1832) applies to this species, but positive identification of his descriptioin with this species appears to be impossible.

SPONDOGONA Raf. Sylva Tellur. 35. 1838.

Dipholis A. DC. in DC. Prodr. (8) : 188. 1844.

The generic name *Dipholis* A. DC., of the Sapotacae is antedated by *Spondogona* Raf., the type of which is *S. nitida*, based upon the *Bumelia salicifolia* of Swartz. The only species of the United States, found on the Florida Keys and also in the West Indies is:

SPONDOGONA SALICIFOLIA (L.) House, comb. nov.

Achras salicifolia L. Sp. Pl. Ed. 2, 469. 1762
Sideroxylon salicifolium Gaertn. Fr. & Sem. (3) : 124. t. 202.
Bumelia salicifolia Sw. Prodr. Veg. Ind. Occ. 50. 1788.
Spondogona nitida Raf., l. c.
Dipholis salicifolia A. DC., l. c.

Several additional species of this genus are found throughout the West Indies.

MINUARTIA L. Sp. Pl. 89. 1753.

The generic name *Minuartia* appears to be the earliest available name for the group of species commonly referred to *Alsine* Wahl. (Not L.), and more recently to *Alsinopsis* Small (Fl. SE. U. S. 419. 1903).

Arenaria verna L. has already been transferred to *Minuartia* by Hiern in 1899, who appears to have made the correct delimitation of this group of species.

MINUARTIA MICHAUXII (Fenzl.) House, comb. nov.

Arenaria stricta Michx. Fl. Bor. Am. (1): 274. 1803. Not *Minaurtia stricta* Hiern. 1899.

Alsine michauxii Fenzl. Verbr. Alsin. Tabl. 18. 1833.

Arenaria michauxii Hook. f. Trans. Linn. Soc. (23): 287. 1867.

Other species of this genus in North America are:

M. ARTICA (Stev.) *Arenaria arctica* Stev.
M. BIFLORA (L.) *Stellaria biflora* L.
M. BREVIFOLIA (Nutt.) *Arenaria brevifolia* Nutt.
M. CALIFONICA (Brewer) *Arenaria californica* Brewer
M. CAROLINIANA (Walt.) *Arenaria caroliniana* Walt.
M. DAWSONENSIS (Britton) *Arenaria dawsonensis* Britton
M. DOUGLASII (Fenzl.) *Arenaria douglasii* Fenzl.
M. GLABRA (Michx.) *Arenaria glabra* Michx. *A. groenlandica* var. *glabra* Fernald. *Alsinopsis glabra* Small
M. GROENLANDICA (Retz) *Stellaria groenlandica* Retz
M. HOWELLII (S. Wats.) *Arenaria howellii* S. Wats.
M. LARCIFOLIA (L.) *Arenaria larcifolia* L.
M. LITOREA (Fernald) *Arenaria litorea* Fernald
M. MACRANTHA (Rydb.) *Alsinopsis macrantha* Rydb.
M. MACROCARPA (Pursh.) *Arenaria macrocarpa* Pursh
M. MARCESCENS (Fernald) *Arenaria marcescens* Fernald
M. NUTTALLII (T. & G.) *Arenaria nuttallii* T. & G.
M. OBTUSILOBA (Rydb.) *Alsinopsis obtusiloba* Rydb.
M. OCCIDENTALIS (Heller) *Arenaria nuttallii* Pax. *Alsinopsis occidentalis* Heller
M. PALUDICOLA (Robinson) *Arenaria paludicola* Robinson
M. PATULA (Michx.) *Arenaria patula* Michx.
M. PROPINQUA (Richards) *Arenaria verna* var. *propinqua* Richards
M. PUSILLA (S. Wats.) *Arenaria pusilla* S. Wats.

M. QUADRIVALVIS (R. Br.) — *Arenaria quadrivalvis* R. Br.
M. ROSSII (Richards) — *Arenaria rossii* Richards
M. SAJANENSIS (Willd.) — *Arenaria sajanensis* Willd.
M. TENELLA (Nutt.) — *Arenaria tenella* Nutt.
M. TEXANA (Robinson) — *Arenaria stricta* var. *texana* Robinson
M. UNIFLORA (Walt.) — *Stellaria uniflora* Walt.

ALSINE L.

The type of the genus *Alsine* L., is *Alsine segetalis* L., a a species congeneric with the several species heretofore placed in *Tissa, Buda, Spergularia* or *Lepigonium.* The species of the Eastern United States are:

ALSINE MARITIMA Pall. Reise Russ. (3): 603. 1776 (*Arenaria rubra marina* L.; *Spergularia salina* J. & C. Presl.; *Alsine media* Crantz, not L.; *Tissa marina* Britton.)

ALSINE RUBRA (L.) Crantz, Instit. (2): 407. 1766. (*Arenaria rubra* L.; *Tissa rubra* Britton).

ALSINE MARGINATA (DC.) Reichenb. Fl. Germ. Excurs. 566. 1832. (*Arenaria marginata* DC.; *Lepigonium marinum* Wahl.; *Buda media* Dumort.; *Alsine marina* Wahl.; *Tissa marginata* Heller; *Spergularia alata* Wiegand).

ALSINE CANADENSIS (Pers.) House, comb. nov.

Arenaria rubra, B, Michx. Fl. Bor. Am. (1): 274. 1803.
A. canadensis Pers. Syn. (1): 504. 1805.
Tissa salina Britton, Torr. Club Bul. (16): 127. 1889 (as to descr., excel. synonymy).
Buda borealis S. Wats. in Gray, Man. Ed. 6, 90. 1890.
Spergularia borealis Robinson, in Gray, Syn. Fl. (1): 252. 1897.

A species of the northern shores of eastern America, which appears to reach its southern limit of distribution on the shore of Shelter Island, opposite Greenport, N. Y., where collected by Peck in 1871.

The following species of this group have been described from or reported from western America.

ALSINE CLEVELANDI (Greene) — *Tissa clevelandi* Greene
ALSINE DIANDRA (Guss.) — *Arenaria diandra* Guss. *Arenaria salsuginea* Bunge: *Tissa diandra* Britton
ALSINE TENUIS (Greene) — *Lepigonium tenue* Greene; *Tissa tenuis Greene; Spergularia tenuis* Robinson

ALSINE MACROTHECA (Hornem.) *Arenaria macrotheca* Hornem.; *Tissa macrotheca* Britton

ALSINE LEUCANTHA (Greene) *Tissa leucantha* Greene

ALSINE GREENEI, nom. nov. *Tissa pallida* Greene; Britton Torr. Club Bul. (16) : 128. 1889. Not *Alsine pallida* Dum.

ALSINE VALIDA (Greene) *Tissa valida* Greene

ALSINE LUTEOLA (Greene) *Tissa luteola* Greene

ALSINE MEXICANA (Hemsl.) *Spergularia mexicana* Hemsl.; *Tissa mexicana* Britton

ALSINE PLATENSIS (Cambess) *Balardia platensis* Cambess; *Lepigonium gracile* S. Wats.; *Spergularia platensis* Fenzl.; *Tissa gracilis* Britton; *Spergularia gracilis* Robinson.

ALSINE BRACTEATA (Robinson) *Spergularia salsuginea* var. *bracteata* Robinson; *S. diandra* Robinson; *Tissa bracteata* Small.

ALSINE SPARSIFLORA (Greene) *Tissa sparsiflora* Greene

ORTHILIA Raf. Aut. Bot. 103. 1840.

Ramischia Opiz, Seznam 82. 1852.
Actinocyclus Klotzsch,, Akad. Monats Berlin (1857) : 14. 1857.

ORTHILIA SECUNDA (L.) House, comb. nov.

Pyrola secunda L. Sp. Pl. 396. 1753.
R. secundiflora Opiz, l. c.
Actinocyclus secundus Klotzsch, l. c.
R. secunda Garcke, Fl. Deuts. Ed. 4, 222. 1858.
O. parvifolia Raf., l. c.

In our northern swamps, merging into the var. OBTUSATA (Turcz.) House, comb. nov. (*Pyrola secunda* var. *obtusata* Turcz.), originally described from northern Asia and Europe, but which appears to be practically the same as described by Paine (Cat. Pl. Oneida County 135. 1865), as var. *pumila*. All intermediate forms between the typical species and the var. *obtusata*, occur in a swamp near Newcomb, New York.

An additional species of this genus occurs in Mexico.

ORTHILIA ELATIOR (Lang) House, comb. nov. (*Actinocyclus secundus elatior* Lange; *Ramischia elatior* Rydberg).

BRAXILIA Raf. Aut. Bot. 102. 1840.

Erxlebenia Opiz, Seznam 41. 1852.
Amelia Alef. Linnaea (28) : 25. 1856.

BRAXILIA MINOR (L.) House, comb. nov.

Pyrola minor L. Sp. Pl. 396. 1753.
Erxlebenia rosea (Smith) Opiz, l. c.
Amelia minor Alef., l. c.
Braxilia parvifolia Raf., l. c.

Common to the subarctic and northern boreal regions of Europe, Asia and America, reaching the eastern United States only in the northern portions of New England and Minnesota and extending southward into the high mountains of Colorado and California.

Plants of Fargo, North Dakota, With Dates of Flowering.

O. A. STEVENS

(*Continued from the last issue.*)

Typhaceae. Cattail Family.

Typha latifolia L. CAT-TAIL.
Ditches and ponds. Common. June 20.

Sparganiacea. Bur-reed Family.

Sparganium eurycarpum Engelm. BUR-REED.
Ditches, sloughs and ponds. Common. June 20.

Potamogetonaceae. Pond-weed Family.

Potamogeton americanus Cham. & Schlect.
In water. Bergman and Stevens, 1910.

Potamogeton perfoliatus L. REDHEAD GRASS.
In water. Bolley in 1891; L. R. Waldron in 1902.

Potamogeton pectinatus L. SAGO PONDWEED.
In water of river. Common. Name from the tubers which are eaten by the wild ducks.

Naiadaceae. Naias Family.

Naias flexilis (Willd.) R. & S.
Ponds. Collected by Lee, but specimen bears no date (No. 1338)

Cammelinaceae. Spiderwood Family.

Tradescantia bracteata Small. SPIDERWORT.
Prairie, fields, and especially in gravel along railroad. Common. May 30 (27). The record of *T. occidentalis* is evidently an error, the specimen being *T. bracteata*.

Melanthaceae. Bunch-flower Family.

Zygadenus chloranthus Richards. CAMAS.
Prairie. Lee in 1891. June 25.

Liliaceae. Lily Family.

Allium stellatum Ker. *PINK WILD ONION.
Prairie. Common. Aug. 5 (2).

Allium reticulatum Don. *WHITE WILD ONION.
Prairie. Frequent. May 20 (22).

Allium tricoccum Ait. WILD LEEK.
Woods. Common.

Lilium umbellatum Pursh. WILD LILY.
Prairie. Lee in 1891. June 25 (24).

Convallariaceae. Lily-of-the-valley Family.

Asparagus officinalis L. ASPARAGUS.
Frequently escaped from cultivation. May 30 (29).

Vaguera racemosa (L.) Morong. FALSE SPIKENARD.
Woods. Occasional. May 30 (30).

Vagnera stellata (L.) Morong. STAR-FLOWERED SOLOMON'S SEAL.
Woods. Frequent. May 20 (20).

Unifolium canadense (Desf.) Greene. FALSE LILY-OF-THE-VALLEY.
Frequent in aspen woods on Minnesota side. May 30.

Uvularia grandiflora J. E. Smith. LARGE-FLOWERED BELLWORT.
Woods. Occasional, common in aspen woods. May 10 (8).

Uvularia sessilifolia L. *SMALL BELLWORT.
Common in aspen woods on Minnesota side, rare on Fargo side. May 15 (13).

Polygonatum commutatum (R. & S.) Dietr. SOLOMON'S SEAL.
Woods and thickets. Common. June 20 (18).

Trilliaceae. Trillium Family.

Trillium cernuum L. NODDING WAKE ROBIN.
Woods. Frequent. May 15 (16).

Smilacaceae. Smilax Family.

Smilax herbacea L. CARRION FLOWER.
Woods and thickets. Common. May 30 (29). Our plant is not especially strong scented.

Juncaceae. Rush Family,

Juncus balticus Willd.
Low wet places. Frequent. June 10.

Juncus interior Wiegand. *PRAIRIE RUSH.
Prairie. Frequent.
Juncus torreyi Coville.
Bolley in 1891.

Araceae. Arum Family.

Arisaema triphyllum (L.) Torr. JACK-IN-THE-PULPIT.
Woods. Common. May 10.

Lemnaceae. Duskweed Family.

Lemna trisulca L. IVY-LEAVED DUCKWEED.
Ponds and ditches. Common.
Lemna minor L. SMALL DUCKWEED.
On ponds and river. Common.
Spirodela polyrhiza (L.) Schleid. LARGE DUCKWEED.
On river with the preceding. Stevens in 1919.

Amaryllidaceae. Amaryllis Family.

Hypoxis hirsuta (L.) Coville. STAR GRASS.
Low prairie. Lee in 1891.

Iridaceae. Iris Family.

Sisyrinchium angustifolium Mill. BLUE-EYED GRASS.
Prairie and uncultivated fields. Common. May 20 (18).

Orchidaceae. Orchid Family.

Cypripedium candidum Willd. SMALL WHITE LADY'S SLIPPER.
Lee in 1891; L. R. Waldron in 1899.
Coeloglossum bracteatum (Willd.) Parl. LONG-BRACTED ORCHIS.
Woods. Occasional. May 20.

Cyperaceae. Sedge Family.

Cyperus erythrorhizos Muhl.
Riverbank. Frequent. Aug. 5.
Cyperus esculentus L.
Riverbank (Oak Grove). A considerable colony, first collected by Stevens in 1918.
Scirpus validus Vahl. GREAT BULRUSH.
Sloughs, ditches and ponds. Common. June 25.
Scirpus heterochaetus Chase.
Ditches west of Agr. College. May 30.
Scirpus paludosus A. Nels. PRAIRIE BULRUSH.
More in low flat areas than the last or next. Common.

Scirpus fluviatilis (Torr.) Gray. RIVER BULRUSH.
Sloughs and ditches. Common. June 10.
Scirpus atrovirens Muhl.
Lee in 1891. June 30.
Heleocharis engelmannii Steud.
Low, wet places. Occasional.
Heleocharis palustris (L.) R. & S. SPIKE RUSH
Pond margins and ditches. Common. May 20 (21).
Heleocharis acicularis (L.) R. & S.
Pond margins and ditches, especially on mud left by retreating water. Common.
Heleocharis wolfii Gray.
Low prairie. Occasional.
Heleocharis acuminata (Michx.) Nees.
Low prairie and ditches. Common. May 25 (25).
Carex rosea Schk
Woods and thickets. Frequent at least on Minnesota side. May 20.
Carex deweyana Schwein. DEWEY'S SEDGE.
Woods. Occasional. May 20.
Carex vulpinoidea Michx. FOX SEDGE.
Low ground. Common. June 20.
Carex gravida Bailey.
Low prairie or near thickets and woods. Common.
Carex stipata Muhl.
Roadside ditch near Agr. College; Stevens and C. H. Waldron in 1910.
Carex marcida Boott.
Prairie, especially lower parts. Common. May 20.
Carex sychnocephala Carey.
Riverbank. Occasional.
Carex straminea Willd.
Three specimens referred here by Bergman.
Carex festucacea Schk. FESCUE SEDGE.
Prairie and roadsides. Common. May 25 (24).
Carex bicknellii Britton.
One specimen referred here by Bergman.
Carex aquatilis Vahl.
Riverbank. Frequent.

Carex laxiflora Lam.
Woods. Frequent. May 25 (27).

Carex tetanica Schk.
Prairie. Stevens in 1920.

Carex polygama Schk. BROWN SEDGE.
Woods on Minnesota side.

Carex gracillima Schwein.
Woods on Minnesota side.

Carex obtusata Lilj.
Low prairie. Stevens in 1920. Quite abundant at least in this particular place (3 mi. NW.)

Carex pennsylvanica Lam.
Woods. Frequent. May 5 (6); woodland form, excluding Apr. 4, 1910. Bergman includes in this a form common on the prairie (*C. heliophile* Mackenzie).

Carex lanuginosa Michx.
Low prairie or ditches. Common. May 20 (21).

Carex trichocarpa Muhl.
Sloughs and other low ground. Common. The var. *aristata* (R.Br.) Bailey perhaps also common.

Carex assiniboiensis W. Boott.
Woods on Minnesota side. Frequent.

Poaceae. Grass Family.

Andropogon furcatus Muhl. BIG BLUE STEM.
Prairie. Common. July 30 (Aug. 1).

Sorghastrum nutans (L.) Nash. INDIAN GRASS.
Prairie. Bolley in 1890.

Syntherisma sanguinalis (L.) Dulac. CRAB GRASS.
Lawn. Stevens in 1920.

Syntherisma humifusum (Pers.) Rydb. SMALL CRAB GRASS.
Lawns or waste ground. Occasional.

Panicum capillare L. WITCH GRASS.
Fields and roadsides. Common. July 5.

Panicum miliaceum L. PROSO MILLET.
Occasionally escaped from cultivation.

Panicum virgatum L. SWITCH GRASS.
Low prairie. Common. July 10.

Panicum perlongum Nash.
Low prairie. Stevens in 1920; very abundant in this particular place (3 miles N. W.) June 20.

Panicum leibergii (Vasey) Scribn.
Prairie. Common. June 20.

Echinochloa crusgalli (L.) Beaur. BARNYARD GRASS.
Fie ds and various low places. Common. July 20.

Chaetochloa glauca (L.) Scribn. YELLOW PIGEONGRASS.
Fields and roadsides. Common. July 15.

Chaetochloa viridis (L.) Scribn. GREEN PIGEONGRASS.
Fields and roadsides. Common. June 25.

Chaetochloa italica (L.) Scribn. ITALIAN MILLET.
Frequently escaped from cultivation.

Cenchrus carolinianus Walt. SANDBUR.
Along N. P. Ry. Stevens in 1918.

Zizania aquatica L. WILD RICE. INDIAN RICE.
Edge of river. Abundant in some years (1910, 1918, 1919), none or rare in others (1920). Aug. 10.

Homalocenchrus oryzoides (L.) Poll. CUT-GRASS.
Riverbank. Common. Aug. 15.

Phalaris arundinacea L. REED CANARY GRASS.
Ditches or low prairie. Frequent. June 20.

Phalaris canariensis L. CANARY GRASS.
L. R. Waldron in 1895.

Hierochloa adorata (L.) Wahl. SWEET GRASS.
Low prairie or roadsides. Common. May 15 (14).

Stipa viridula Trin. FEATHER GRASS.
Prairie and roadside. Frequent. June 15 (15).

Stipa comata Trin. & Rupr. NEEDLE GRASS.
Along railroad (introduced in gravel?) Occasional.

Stipa spartea Trin. PORCUPINE GRASS.
Prairie. Frequent. June 25 (one year only; *viridula* on same date).

Oryzopsis asperifolia Michx. MOUNTAIN RICE.
Aspen woods on Minnesota side. May 10.

Oryzopsis racemosa (Sm.) Ricker.
Woods. Occasional.

Muhlenbergia mexicana (L.) Trin.
Woods. Frequent. Aug. 15.

Muhlenbergia racemosa (Michx) B. S. P. WILD TIMOTHY.
Woods and roadsides. Common.

Muhlenbergia foliosa Trin.

A specimen from the aspen woods on the Minnesota side seems to belong here (Stevens in 1918).

Muhlenbergia cuspidata (Torr.) Nash.
Prairie. Stevens in 1920. June 25.

Phleum pratense L. TIMOTHY.
Roadsides. Common. July 5.

Alopecurus geniculatus L. MARSH FOXTAIL.
Low fields, ditches, pond and river margins. Common. June 5 (4).

Alopecurus pratensis L. MEADOW FOXTAIL.
Field (planted?) near Sacred Heart Academy. Plowed up in 1920. May 30.

Sporobolus neglectus Nash. SMALL RUSH GRASS.
Dry roadsides, walks, and lawns. Common. Aug. 15.

Sporobolus asper (Michx.) Kunth. LONG-LEAVED RUSH GRASS.
Prairie. Frequent. (Seen both south and north of town in 1920 but not previously recorded.)

Sporobolus cryptandrus (Torr.) Gray. DROPSEED GRASS.
Along railroad track (introduced?); Bergman in 1910.

Sporobolus heterolepis Gray. NORTHERN DROPSEED.
Prairie. Common. July 25.

Agrostis alba L. REDTOP.
Ditches or other wet ground. Frequent. June 25.

Agrostis hyemalis (Walt.) B. S. P. HAIRGRASS.
Prairie and uncultivated fields. Common. July 5.

Calamagrostis hyperborea Lange. REED GRASS.
Low prairie, sloughs etc. Frequent. June 30.

Avena fatua L. WILD OATS.
Fields and roadsides. Common. June 25.

Avena torreyi Nash.
Aspen woods on Minnesota side. Occasional.

Spartina michauxiana Hitch. CORD GRASS.
Low prairie, roadsides, ditches, etc. Common.

Beckmannia erucaeformis (L.) Host. SLOUGH GRASS.
Sloughs, ditches and other wet soil. Common. June 20 (19).

Bouteloua oligostachya (Nutt.) Torr. BLUE GRAMA.
Prairie. Occasional. Also introduced in gravel along the railroad tracks.

Atheropogon curtipendulus (Michx.) Fourn. TALL GRAMA.
Prairie. Frequent.

Phragmites phragmites (L.) Karst. REED.
Sloughs. Frequent.

Eragrostis purshii Schrad.
Along railroad. Stevens in 1910.

Eragrostis major Host. STINKGRASS.
Fields and roadsides. Frequent. July 20.

Eragrostis hypnoides (Lam.) B. S. P.
On mud along river bank. Common.

Sphenopholis obtusata (Michx.) Scribn.
Low prairie. Stevens in 1920.

Koeleria cristata (L.) Pers. PRAIRIE JUNE GRASS.
Prairie. Common. June 20 (21).

Distichlis spicata (L.) Greene. SALT GRASS.
Low flat alkaline spots. Frequent. June 25.

Dactylis glomerata L. ORCHARD GRASS.
Roadsides. Occasional.

Poa pratensis L. KENTUCKY BLUE GRASS.
Prairie, roadsides and various places. Common. June 10 (9).

Poa compressa L. CANADA BLUE GRASS.
Occasional in various places. June 20 (20).

Poa triflora Gilib. FALSE REDTOP.
Low prairie, sloughs, etc. Common. June 20.

Poa nemoralis L.
One specimen referred here by Bergman.

Scolochloa festucacea (Willd.) Link. *HOLLOW STEM.
Ditches, edges of ponds etc; in water at least during the wetter portions of the year. June 15. This name I found in use near Rugby, N. D.

Panicularia grandis (S. Wats.) Nash. *TALL MANNA GRASS.
Ditches, sloughs, pond margins, etc. Common. June 20 (19).

Panicularia borealis Nash. SLENDER MANNA GRASS.
Pond margins. Occasional.

Festuca elatior L. MEADOW FESCUE.
Roadsides. Occasional. June 15.

Festuca nutans Willd. NODDING FESCUE.
Woods. Occasional.

Bromus polyanthus Scribn.
Lee in 1892. Cultivated or escaped.

Bromus japonicus Thunb. CHESS.
Streets. Occasional. (*B. commutatus* of Bergman's Flora).

Bromus purgans L. WOOD CHESS.
Woods. Common. The var. *incanus* Shear, frequent.

Bromus inermis Leyss. BROME GRASS.
Roadsides. Common. June 20 (18). As this is the common bromegrass of cultivation the name may be used without qualifying adjectives. It is quite commonly spoken of as "Bromus inermis" or simply "Bromus."

Lolium perenne L. PERENNIAL RYE GRASS.
Roadsides. Occasional. Common in new lawns, being used in grass seed mixtures, for temporary cover. June 15.

Agropyron caninum (L.) R. & S. BEARDED WHEAT GRASS.
Prairie and roadsides. Frequent.

Agropyron tenerum Vasey. SLENDER WHEAT GRASS.
Prairie, roadsides and fields. Common. June 20 (18). This is generally known commercially as "Western rye-grass."

Agropyron repens (L.) Beauv. QUACK GRASS.
Streets, roadsides and fields. Common. June 20 (18).

Agropyron smithii Rydb. WESTERN WHEAT GRASS.
Prairie, fields and roadsides. Common. June 20.

Hordeum jubatum L. WILD BARLEY.
Prairie, roadsides and fields, especially in sloughs or other low ground. Common. June 20 (20). This is called by most people in this State "Foxtail."

Elymus virginicus L. TERREL GRASS.
Woods or low open ground. Common. July 5.

Elymus canadensis L. WILD RYE.
Prairie and roadsides. Common. A tall form in the woods.

Elymus glaucus Buckley.
L. R. Waldron in 1898.

Elymus macounii Vasey.
Low prairie and sloughs. Common. June 25.

Elymus diversiglumis Scribn. & Ball.
Woods. Occasional.

Elymus striatus Willd. SLENDER WILD RYE.
Woods on Minnesota side. Stevens in 1920.

Hystrix hystrix (L.) Millsp. BOTTLE-BRUSH GRASS.
Woods. Frequent at least on Minnesota side near the aspen woods.

Ophioglossaceae. Adder's-tongue Family.

Botrychium virginianum (L.) Sw. MOON WORT.
Woods. Occasional.

Polypodiaceae. Fern Family.

Dryopteris cristata (L.) A. Gray. SHIELD FERN.
Woods. Occasional.

Matteuccia struthiopteris (L.) Tod. OSTRICH FERN.
Woods of Red and Sheyenne rivers. Occasional.

Equisetaceae. Horse-tail Family.

Equisetum arvense L. HORSETAIL.
Bolley in 1892.

Equisetum pratense Ehrh.
Riverbank. Frequent.

Equisetum hyemale L. SCOURING RUSH.
Low places and in gravel along roadsides. Frequent.

Lycopodiaceae. Club Moss Family.

Lycopodium complanatum L. CLUB MOSS
A specimen said to have been collected in woods along the Sheyenne river, but I think there must be some error in the record.

A few records of cultivated plants have been kept, and some of native species not found in the Fargo region. The latter are often of only a single season and were taken at various places in the state. In a few cases such data have been used in the preceding list. In the following list where the locality is not given, the east central part of the state is the source of the record.

CULTIVATED PLANTS

Acer saccharinum L. SILVER MAPLE. Apr. 10 (10).
Betula papyrifera Marsh. PAPER BIRCH. May 10.
Caragana arborescens Lam. SIBERIAN PEA-TREE. May 20 (21).
Crocus vernus All. CROCUS. May 10 (8); excluding the extremely early record of March 21, 1910.
Eleagnus argentea Pursh. SILVERBERRY. Wild Olive. May 30.
Hippophae rhamnoides L. SEA THORN. May 15.
Juniperus virginiana L. RED CEDAR. May 5.
Lipidium draba L. HOARY CRESS. PERENNIAL PEPPERGRASS. June 10 (11).

Lonicera tatarica L. TARTARIAN HONEYSUCKLE. May 20 (20).
Medicago falcata L. SICKLE LUCERN. June 10 (8).
Populus balsamifera L. BALSAM POPLAR Apr. 30.
Ribes aureum Pursh. GOLDEN CURRANT. May 10.
Scilla (*sibirica* Andr.?) SQUILL. May 5 (4).
Secale cereale L. WINTER RYE. June 10.
Sorbus americana Marsh. MOUNTAIN ASH. May 30 (28).
Syringa vulgaris L. LILAC. May 20 (19).

NATIVE PLANTS NOT OCCURING AT FARGO.

Androsace puberulenta Rydb. Apr. 12, 1910 at Minot.
Asclepias speciosa Torr. SHOWY MILKWEED. July 5.
Astragalus crassicarpus Nutt. GROUND PLUM. April 12, 1910 at Minot.
Astragalus flexuosus Dougl. June 5.
Astragalus missouriensis Nutt. April 12, 1910 at Minot.
Astragalus pectinatus Dougl. Full flower at Williston, June 4, 1918.
Astragalus plattensis Nutt. May 5; Apr. 12, 1910 at Minot.
Brauneria angustifolia (D C.) Heller. PURPLE CONE FLOWER June 25 (27).
Campanula rotundifolia L. BLUE BELLS. June 20.
Castilleja sessiliflora Pursh. June 5.
Chamaerhodos erecta (L.) Bunge. June 4, 1918 at Williston.
Chamaenerion angustifolium (L.) Scop. FIREWEED. June 20; first flowers at Bottineau, June 9, 1917.
Coryphantha vivipara (Nutt.) Britton & Rose. PURPLE CACTUS. June 13, 1918 at Hettinger.
Crepis runcinata (James) T. & G. June 10.
Cryptantha calycosa (Torr.) Rydb. June 23, 1918 at Bowman.
Delphinum bicolor Nutt. In flower a few days at Williston, June 4, 1918.
Erigeron asper Nutt. June 5.
Eriogynum flavum Nutt. June 25.
Erysimum asperum D C. WESTERN WALLFLOWER. June 5.
Gaillardia aristata Pursh. June 15 (17).
Hymenopoppus filifolius Hook. First flowers at Hettinger, June 13, 1918.
Hypoxis hirsuta (L.) Coville. STARGRASS. June 10.

Lesquerella arenosa (Rich.) Rydb. May 5; Apr. 12, 1920 at Minot.

Lupinus argenteus Pursh. In flower a few days at Hettinger, June 13, 1918.

Lupinus pusillus Pursh. In flower a few days at Hettinger, June 13, 1918.

Lygodesmia juncea (Pursh.) D. Don. Skeleton Weed. June 25.

Malvastrum coccineum (Pursh.) A. Gray. False Mallow. June 15 (17).

Meriolix serrulata (Nutt.) Walp. June 15.

Mertensia lanceolata (Pursh.) DC. May 5; Apr. 12, 1910 at Minot.

Musineon divaricatum (Pursh.) C. & R. Full flower at Williston. June 4, 1918.

Opuntia polycantha Haw. Prickly Pear. June 30.

Oreocarya glomerata (Pursh.) Greene. In flower for some days at Williston. June 4, 1918.

Orophaca caespitosa (Nutt.) Britton. Minot, Apr. 12, 1910.

Oxytropis lambertii Pursh. Purple Loco. June 5.

Oxytropis splendens Dougl. Showy Loco. June 30, Northern parts of the State.

Parnassia palustris L. July 5.

Paronychia sessiliflora Nutt. June 25.

Pentstemon albidus Nutt. White Beardtongue. June 5 (5).

Pentstemon angustifolus Pursh. In flower for some days at Williston, June 4, 1918.

Phacelia leucocarpa Torr. In flower some days at Bowman, June 20, 1918.

Phlox hoodii Rich. *Moss Phlox. May 5; Apr. 12, 1910 at Minot.

Picradeniopsis oppositifolia (Nutt.) Rydb. First flowers at Bowman, June 25, 1918.

Plantago eriopoda Torr. May 10, 1910 at Hankinson.

Polygala alba Nutt. White Milkwort. June 15.

Potentilla concinna Rich. May 10; Minot and vicinity.

Ranunculus aquatilis L. June 10.

Ranunculus glaberrimus Hook. Apr. 19, 1913 at Marmarth.

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*The word "moss" appears so frequently in popular names for this plant that this name is suggested.

Ranunculus septantrionalis Poir. June 5.
Senecio integerrimus Nutt. June 5.
Sideranthus spinulosus (Nutt.) Sweet. July 15.
Sideranthus grindelioides (Nutt.) Britton. In flower for some days at Bowman, June 20, 1918.
Thelypodium integrifolium (Nutt.) Endl. In flower for some days at Tappen, July 11, 1919.
Viola nuttallii Pursh. NUTTALL'S VIOLET. May 5; Apr. 12, 1910 at Minot.

The name of Thomas Nuttall, one of the early American naturalists, is well commemorated in this pretty little violet which is one of the characteristic spring flowers of the western part of the state. He described many of our plants for the first time from specimens collected along the Missouri River in 1810. (Note how often his name occurs in the above list.)

SEASONAL LIST.

The following arrangement of the Fargo plants according to time of flowering may be useful:

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
Apr. 10,	Hazelnut	Shepherd's Purse	
15,	Pasque Flower		
20,	Buffalo Berry	Frenchweed	
	White Elm		
	Praire Buttercup		
	Aspen		
25,	"Pussy" Willows		
	Cottonwood		
	Box Elder		
	Whitlow Grass		
30,	Bloodroot	Dandelion	
	Androsace		
May 5,	Violets		*Carex pennsylvanica*
10,	Kidney-leaved Buttercup	Silver Weed	Mountain Rice
	Corydalis		
	Wood Anemone		
	Large Bellwort		
	Wild Strawberry		
	Juneberry		
	Wild Plum		
	Cat's Foot		

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
	Sweet Colt's Foot		
	Jack-in-the-Pulpit		
15,	Field Chickweed		Sweet Grass
	Ash		
	Peach-leavedWillow		
	Prickly Ash		
	Pin Cherry		
	Wild Black Currant		
	Gooseberry		
	Nodding Wake-Robin		
	Small Bellwort		
	Dwarf Raspberry		
	Iron Wood		
20,	Red Haw	Water Pod	Spike Rush
	Blue-eyed Grass	Monolepis	*Carex dewayana*
	Milk Vetch	Meadow Parsnip	" *lanuginosa*
	Star-flowered Solomon's Seal		" *marcida*
			" *rosea*
	Choke Cherry		
	Praire Violet		
	Puccoon		
	White Wild Onion		

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
	Large Red Haw		
	Orchis		
	Honeysuckle		
25,	Early Meadow Rue	Violet Wood Sorrel	*Carex festucacea*
	Moehringia	Speedwell	" *laxiflora*
	Sandbar Willow	Low Stickseed	Spike Rush
	Columbine	Meadow Parsnip	
	Baneberry		
	Yellow Water Crowfoot		
	Blue Cohosh		
	Bur Oak		
	False Spikenard		
	Golden Ragwort		
30,	Waterleaf	Peppergrass	*Scirpus heterochaetus*
	Spiderwort	Tansy Mustard	Meadow Foxtail
	Sweet Cicely	Bedstraw	
	Wild Vetch	Ditch Buttercup	
	Black Haw	Seaside Buttercup	
	Prairie Groundsel	Common Mustard	
	Asparagus	Blue Stickseed	
	Carrion Flower	Knotweed	
	False Spikenard		

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
	Horseradish		
	Honewort		
	False-lily-of-the-Valley		
June 5,	White Clover	Hare's Ear Mustard	Marsh Foxtail
	Yellow Vetchling	Black Medic	
	Canáda Anemone	Sorrel Dock	
		Willow-leaved Dock	
10,	Macouns Buttercup	Fleabane	Kentucky Blue Grass
	Smooth Wild Rose	Tumbling Mustard	Rush
	Red Clover	Spurge	River Bulrush
	Alsike Clover	Flixweed	
	Northern Nedstraw	Yellow Wood Sorrel	
	Figwort	Knotweed	
	Alfalfa	Stickseed	
	Gaura	Prairie Bird's Foot Trefoil	
	Black Snakeroot		
	Tall Anemone		
	Cancer Root		
	Wild Grape		
	Dogwood		
	Pemina		
	False Dandelion		

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
15,	Wild Rose	Wild Four O'clock	Feather Grass
	Yellow Sweet Clov'r	Milfoil	Hollow Stem
	Bushy Vetch	Creeping Pigweed	Meadow Fescue
	Cotton Weed	Indian Mustard	Perennial Rye-grass
	Large Wild Flax	Dog Mustard	
	False Gromwell	Leafy Spurge	
	Alum Root	Corn Cockle	
	Wild Raspberry	Pink Cockle	
	Sumac	Collomia	
		Bindweed	
		Wild Parsnip	
		Bracted Vervain	
		Wormseed Mustard	
20,	Milkweed		Brome Grass
	Gaillardia	Downy Bindweed	Slender Wheat Grass
	Solomon's Seal	Quackgrass	Western Wheat Grass
	Spreading Dogbane	Marsh Yellow Cress	Slough Grass
	Slender Beardtong'e	Indian Hemp	Large Manna Grass
	Hairy Rock Cress	Dragonhead	Canada Blue Grass
	Flax	Cinquefoil	False Red Top
	Yellow Avens	Sleepy Catchfly	Prairie June Grass
	Tipsin	Wild Barley	Fox Sedge
	Goatsbeard	Lambsquarters	*Panicum perlongum*

TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
Arrow-head	False Sunflower	" *liebergii*
Cattail	Clammy Weed	Reed Canary Grass
Burreed	Purslane	
	Russian Thistle	
	Dog Fennel	
25, Wild Lily	Plantain	Great Bulrush
Marsh Vetchling	Milkweed	Porcupine Grass
Wolfberry	Tall Cinquefoil	*Muhlenbergia cuspidata*
White Sweet Clover	Wild Liquorice	Red Top
Tall Meadow Rue	Mallow	Salt Grass
Moonseed	Hartweg's Tansy Mustard	Macoun's Wild Rye
Shinleaf	Catchfly	
Loosestrife	Wild Buckwheat	
White Avens	Toadflax	
Corn Flower	Green Pigeon Grass	
Water Plantain	Wild Oats	
Camas		
30, Psoralea	Hedge Nettle	Reed Crass
Hop	Water Hemlock	*Scirpus atrovirens*
Fringed Loosestrife	Golden Dock	
Monkey Flower	Field Bindweed	
Golden Aster	Blue Vervain	
Wild Lettuce	Wild Mint	

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
		Daisy Fleabane	
July 5,	Larkspur	Blue Wild Lettuce	Witch Grass
	Wild Lettuce	Pigweed	Timothy
	Little Rattle Pod	Sunflower	Hair Grass
	Meadow-sweet	Prairie Thistle	Terrel Grass
	Catnip	Coneflower	
	Lead Plant	Nettle	
		Rocky Mountain Bee prant	
		Long-rooted Smartweed	
		Ground Cherry	
		Germander	
		Spiny Sow-thistle	
10,	Purple Prairie Clover	Evening Primrose	Switch Grass
		Wood Nettle	
	Swamp Milkweed	Narrow-leaved Vetch	
	Whorled Milkweed	Kinghead	
	Ditch Stonecrop	Common Sunflower	
		Perennial Sowthistle	
15,	Lopseed	Prickly Lettuce	Yellow Pigeon Grass
	Motherwort	Smartweed	
20,	False Anise	White Vervain	Stink Grass

	TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
	Wild Bergamot	Horseweed	
		Bull Thistle	
		Barnyard Grass	
25,	False Boneset	Tall Smooth Goldenrod	Northern Dropseed
	Tall Coneflower		
30,	Ironweed	Narrow-leaved Sunflower	Big Blue Stem
	Obedient Plant	Rough Sunflower	
	Wild Cucumber	Ragweed	
		Ladies' Thumb	
		Field Dodder	
		Western Water-horehound	
		Gumweed	
		Burdock	
		Canada Thistle	
Aug. 5,	Pink Wild Onion	False Aster	
	Blazing Star	Gronovius Dodder	
	Virgin's Bower	Cocklebur	
10,	Hog Peanut	Canada Goldenrod	Wild Rice
	Absinth	Stiff Goldenrod	
		Saltbush	
		Wormwood	
15,	White Lettuce	Pale Goosefoot	Cut Grass
	White Prairie Aster	Cocklebur	*Mullhenbergia mexicana*

TREES, FLOWERS, ETC.	WEEDS	GRASSES, SEDGES, ETC.
	Beggar Ticks	Small Rushgrass
20, Smooth Purple Aster	Tall White Aster	
	Artichoke	
	Marsh Elder	
	Bur Marigold	
25, *Nabalus racemosus*	Red Goosefoot	
	White Sage	
30,	Wormwood	
Sept. 15, Rayless Aster		

Albino Robins at Notre Dame.

BY BROTHER ALPHONSUS, C. S. C.

The robin seems to be a species in which albinos are not uncommon. Within the past six years there have appeared in the South Bend area two complete albino robins, and two that were partial albinos. These birds naturally attracted the attention of every one who visited the regions where they were staying.

The first white robin to be seen at Notre Dame was in the month of July, 1915. This bird, which made its home in the vicinity of the Grotto, was probably an old one, for no person had observed the parents feeding it at any time. In fact, this albino seemed to be looked upon by the other birds as an intruder, and was persecuted by them. It remained near the Grotto about a month, and then disappeared.

The color of this albino was not snow-white, but was of a less intense quality. It was, however, entirely white, and made a pretty picture when seen on the lawn or in the mulberry trees near the Grotto. These trees, no doubt, were what attracted the bird to the spot during the time the berries were ripe.

In the spring of 1920 a partial albino robin was observed on the grounds at Notre Dame near the Community House. A similar specimen was seen in the same place in the spring of 1921. This circumstance would seem to point to the fact that the identical bird of 1920 returned again in 1921. My observations of this robin were not extensive enough to ascertain whether or not it breeded here either year. Whenever I saw the bird it was alone.

On July 5, 1921, Mr. W. H. Woollums of South Bend, Indiana, came to Notre Dame to acquaint the writer of the presence of a white robin, which, he said, had been hatched in a tree near his home in River Side Park. Mr. Woolums invited me to go with him to see this albino robin, and I did so the following day.

We arrived in the park at 9:45 a. m., and found the white robin just at the edge of the grass taking a bath in a pool of water made by a leaking hose. Mr. Woolums went into his house and got some bread crumbs. He approached the bird within ten feet and threw the crumbs to it; but the robin was enjoying its bath too much to heed anything else. Presently it felt satisfied and flew to a swing, which was nearer to us both. Here it remained a few minutes, giving us an excellent view. From the swing the albino went up into an elm tree just overhead, where it rested and preened its feathers.

Three days later I made another trip to River Side Park in company with Dr. J. W. Hornbeck, an ornithologist from Northfield, Minn. We arrived at the park at 10:15 a. m., but could not locate the bird for ten minutes. At length a lady who feeds the robin daily, decried it in a tree near her house. Here we observed the bird with our field glasses for five minutes, hoping it would descend to the lawn where we could see it better. It soon began to flutter in the trees, and then flew across the street and alighted in another tree. We followed it, but not too closely. In another minute it descended to the ground, and suddenly the male bird and another young robin came up to the albino. The old bird had a worm in its bill, which was intended for the white fledgling, but was grabbed by its greedy brother. The albino then flew towards the river, but we did not follow it any further. Our view of these robins had been quite satisfactory, and was, perhaps, an experience that few other bird lovers had ever enjoyed.

Dr. Hornbeck, with his powerful field glasses, found the eyes of the albino to be yellowish-pink. Various opinions about the color of the bird's eyes had been expressed by different observers, the more general one being that it was some shade of pink. The bill was a lighter yellow than in the ordinary robin. These variations from the normal robin's eyes and bill seemed to harmonize with the albino's plumage. On the head and throat the color was a dusky white.

Mr. Woolums told me he first discovered this albino on May 23, soon after it had left the nest. At the present writing (July 10) the bird would be about seven weeks old. I was surprised to learn that the parents feed their young so long

after they have been fledged. The lady's custom of feeding this albino has made it extremely confiding, for it will approach a person within two or three feet. Many kodak pictures of this white robin have been taken, and I give here four of them grouped together.

BOOK REVIEWS

In this section are reviews of new, or particularly important and interesting books in the fields of natural science. Books dealing with botany or kindred subjects should be sent to the Editor, the University of Notre Dame. *All other books for review* should be sent to Carroll Lane Fenton, at the Walker Museum, the University of Chicago, Ill. Publishers are requested to furnish prices with books.

TREES, STARS, AND BIRDS. By Edwin Lincoln Mosely. World Book Company, 1920. $1.80.

This is a book designed primarily for use in schools, but it will be of value to anyone who wants to find out the more essential facts about the things which Mr. Mosely discusses. The style is interesting, and the facts, while not new, are exactly those which most people do not know. The numerous quotations from poets serve to link the natural science of the book with the literature of the world, and they do it far better than could any long formal essay on the relation of poets and nature.

The section of the book devoted to trees is almost a complete popular manual for their study. There is an excellent discussion of the structure of the limbs, trunk, and roots, of various typical tree groups, and of the proper ways in which to care for trees, both old and young. The second part of the book, headed "Stars," not only treats of stars, but the planets, satellites, and nebulae. It, like the rest of the book, is non-technical, but is at the same time accurate and specific.

It is the third section, however—that on birds,—which most arouses my enthusiasm. That section should be enlarged a little by discussions of some of the general facts and problems of ornithology, and then

published as a separate book. I believe it would be accepted with enthusiasm by people all over the country who find the ordinary beginner's bird manual too conventional and stereotyped to arouse either their own enthusiasm or that of their children. The interesting discussions of the various families, the excellent half-tones, and the sixteen pages of colored plates by Louis Agassiz Fuertes make this section one of the finest popular treatments of the birds of North America that has appeared in some years. C. L. F.

THE BURGESS BIRD BOOK FOR CHILDREN. By Thornton W. Burgess. Little, Brown, and Co. $3.00.
THE BURGESS ANIMAL BOOK FOR CHILDREN. By Thornton W. Burgess. Little, Brown, and Co. $3.00.

The problem of writing a book on birds that interests small children, and at the same time give them sound, reliable information has been well handled by Mr. Burgess in his "Bird Book for Children." Because there is no method of approach to the child mind that equals the story, this method has been adopted, but with considerably more success than in the "Bed-time Story Books" by the same author. The effort to keep the stories within the realm of childhood probability has succeeded, and the result is Mr. Burgess at his best.

The book is a series of stories, told by Peter Rabbit, Johnny Chuck, Striped Chipmunk, and the birds themselves. Every page is crowded with interesting facts of bird lore, so cleverly inserted into the conversations of the woodland people that there are no formal description, no fine text, and no footnotes. Fifty-eight species of birds are treated in detail, and many others are mentioned briefly. The whole work is so lively, so real that few children of the ages for which it is designed can resist its appeal.

The workmanship of the book deserves as much credit as the text. There are colored plates, from paintings by Louis Agassiz Fuertes, of each of the fifty-eight species that appear most prominently in the book. The paper, printing, and binding are excellent, and the child who takes pride in a good-looking book will be satisfied by this one.

The "Animal Book for Children" is a fit companion for the "Bird Book." The same method of story-telling is employed, with quite as much success. The word 'animal' is used instead of 'mammal,' which has little meaning to the child. There are no technical terms, no descriptions of subspecies, and no classifications. The sole purpose of the book is to help children to gain an intimate acquaintance with the field and wood, mountain, and plain—the animals which are "in the truest sense the first citizens of America."

The illustrations, again by Fuertes, are both in color and in black-and-white. In some cases the coloring and printing of the plates are faulty, and the black-and-white pictures are much the better of the two. The book is, pnfortunately, a trifle smaller than its companion volume, but the general workmanship is quite as good, and the binding even more attractive—not a small consideration in the likes and dis-

likes of children. Both books are distinct accomplishments, and are just what nature-loving parents and teachers, and children who like the animal people of their world, have been wanting for years.

C. L. F.

THE METHOD OF SEARCH

Seek. See. Seize. Follow. Forbear.

How scale this barrier of rocks and overhanging boulders? Silently humble.

Without conceit in the past, without fancy of the future.

For to assume is to presume.

A healthy dissatisfaction is not the same as discontent.

Accept not for true on the bare assertion. Verify.

For it is usually ignorance which keeps people content with the worse; or, in the pithy word of Shakespeare, "There is no darkness but ignorance."

The summary of the section says that it deals with such subjects as: The Spirit of Search, The Need for Inquiry, Difference, and Continuous Oneness of Man. I shall take the summary at its word, being unable to find that it actually deals with anything whatever. The third section deals largely with disease, such as cancer, and has numerous pictures that are quite intelligible.

How are books like this allowed to come into existence? What sort of person, possessing any education whatever, will perpetrate such tommy-rot? Here are 324 pages of letter-press, printed on first-class paper, and bound as well as the average book of today. There are 322 line drawings and half tones, and several plates in color. And the total value of the book is less than nothing by the value of the materials used and the work consumed in its production. Science is neither mysticism nor scissors-work. Popular science, of course, must be dependent upon research work, and in that sense be parasitic, but it does not consist of making dozens upon dozens of clippings and tying them together by a few ill-phrased sentences.

I have just received a book by an Englishman, prominent among the anti-vivisectionists, who maintains that science is responsible for the woes of the world. This creation of Mr. Trumbull's makes me believe the anti-vivisectionist, at least to the point where I wish science had never invented the printing press, or for that matter even a language and alphabet. CARROLL LANE FENTON.

A CENTURY OF SCIENCE IN AMERICA. Edited by Edward Salisbury Dana. Yale University Press. $4.00.

In 1918 occurred the centennial of a remarkable journal—The American Journal of Science, published at New Haven, Connecticut. In commemoration of the event there has been published a large volume, composed of several chapters by various specialists, these chapters portraying the development of science in this continent, with particular reference to the Journal.

The opening chapter, by the present editor of the Journal, Dr. Edward S. Dana, traces in detail the early history of the magazine and gives a sketch of its subsequent history. There is a table of scientific periodicals from 1771 to 1832, and a review of the various early svientific societies in Europe and America. The American Journal of Science was founded in 1818 by Benjamin Silliman, then "professor of chemistry, mineralogy, etc. at Yale College." Silliman had doubts as to the quantity of good material that he could get for his publication, and the support it would receive, so he widened its field as much as possible. The title-page of the first number states that the journal will deal with "Minerology, Geology, and the other branches of Natural History; including also Agriculture and the Ornamental as well as Useful Arts." It is interesting to contrast that with the present-day Journal, which is almost entirely restricted to mineralogy and geology, and finds difficulty in publishing the manuscripts that come in to it.

Dr. Dana tells of the completion of the first series of the Journal, of the changes in scope and staff, and of the addition of James Dwight Dana as associate editor. The history of the Journal up to its present issues is treated more briefly than is the early history, but is detailed enough to give the facts desired.

The remaining chapters of the book deal with various subjects of science. Of the twelve, five are concerned with geology, and one each with petrology, minerology, geophysics, chemistry, physics, zoology, and botany. The authors include such authorities as Charles Schuchert, Richard Swann Lull, William E. Ford, and Leslie R. Coe. They give excellent summaries of the subjects assigned them, and make the book an excellent one for reference. A feature of interest are the 22 portraits of scientific men of America and Great Britain.

C. L. F.

GENERAL BOTANY FOR UNIVERSITIES AND COLLEGES. By Hiram D. Densmore. Ginn and Company. $2.96.

The first part of this new text on botany is intended to present the biological aspects of plant life from the standpoints of structure and function and is based upon studies of the higher and more familiar seed-bearing plants. Three main themes are considered: the relations and adaptations of the higher plants to other organisms and to the inanimate portions of their environments; the cellular structure of plants in relation to their growth, reproduction and anatomy; and the phenomena of reproduction with relation to crossing, hybridization, and plant breeding.

Part II deals with the morphology, life histories, and the evolution of the main plant groups. In the chapter devoted to the fungi, emphasis is placed on the nature of enzymes and fermentation, and on the relations of these processes to parasitism, disease, and decay. In the treatment of the higher spore-bearing plants, and seed plants much attention is given to the evolution of structure and reproduction, instead of placing the emphasis upon the mere reproductive features, as

is done in a great many of the older elementary text-books. In parts relating to structure, the newer conceptions of anatomy are followed.

Part III is designed to serve as an introduction to field work, and to a knowledge of the more interesting and important biological and economic aspects of a few important families and species among the spring plants. There is a considerable discussion of trees and their importance to man, and the main problems of forestry are emphasized by examples of the life of a few selected species of forest trees. The herbaceous monocotyledons, and the dicotyledons are studied from their biological and economic aspects, and their treatment is designed to serve as a guide for studies in other species.

Throughout the text the plants are presented as living organisms, comparable to animals, and with similar physiological life functions. The purely technical portions are linked up with the theoretical and economic aspects of the subject in a manner that brings the information home clearly and definitely. The treatment of hybridization and kindred subjects is as good as it is uncommon. The chapters on plant physiology are summarized and closely correlated with the seasonal life of such common plants as the bean, clover, and locust. Physiological processes are thus made directly applicable to seasoned life of species that very one knows, and can study.

Mechanically the book leaves little to be desired. The paper, presswork, and binding are excellent, and the book will not come to pieces at once when placed in the student's hands. The illustrations, both from photographs and drawings, are numerous, good, and excellently chosen. M. J. A.

THE NEW STONE AGE IN NORTHERN EUROPE. By John M. Tyler. Charles Scribner's Sons, 1921. $3.00.

Henry Fairfield Osborn produced a bookon the men the Old Stone Age; Dr. Tyler has done the same for those of the New. He begins at the point where Osborn left off, and carries man on to the dawn of history, taking up in detail the migrations, cultures, daily activities, and existing relics of these ancient ancestors of ours.

Where and how man originated is still pretty much of question. We know that the earliest remains of man-like animals are found in southern and southeastern Asia. In those same regions today are the great apes that are probably descended from the same ancestors that gave rise to man. From the first ape-man to the high types of the Old Stone Age is a long step, but as Dr. Tyler is concerned mainly with the descendents of the Old Stone people, he covers it rather briefly.

The change from the age of the chipped stone implements to that of polished ones took place in northern Europe about fifteen to twenty thousand years ago. Researches in Asia indicate that there the transition was considerably earlier, and that the New Stone men migrated westward from the region of the Iranian plateau. However that may be, the relics of the shell heaps of Denmark and Scandinavia show that some thousands of years after the Cro-Magnon people made their

beautifully colored pictures in the caves of France, men in northwestern Europe were just beginning to polish stone instead of chipping it.

Dr. Tyler shows that the earlier New Stone Age men were possessed of quite high civilization. They buried their dead, built temples, farmed, had numerous domesticated animals, made excellent pottery, plaited nets, and did rude weaving. Some of them built elaborate dwellings on the borders of lakes, while others lived exclusively on land. They seemingly had few wars, for their implements are all designed primarily for hunting or industry of other sorts.

The further evolution of man was largely one of ethics and invasions. Dr. Tyler shows how the continued influx of more highly cultured peoples from the east, bringing with them different ideas and customs from those of the European New Stone peoples forced many changes in life. The continent became crowded, and war was the result. Along with war came the necessity for social life, pooling of interests, and steady progress. Thought, both philosophical and practical, was stimulated. Metals superceded stone, and the New Stone Age was past. Remnants of it lingered on to the time of the Romans, but only in the secluded mountainous or heavily forested districts. C. L. F.

AN INTRODUCTION TO PALEONTOLOGY. By A. Morley Davies. London, Thos. Murby and Co.; New York, D. Van Nostrand and Co. $3.50.

Mr. Davies has designed his book for purposes of teaching, particularly of elemetary teaching. For this reason he begins with the animals that are most common as fossils, and which can most easily be studied by the beginner—the Brachiopoda. The method of treatment is to first describe some common species, from which the student can get an idea of the general characters and variations of the group studied, and then give a brief systematic account of the entire group. References to living forms are rather few, and the illustrations are almost all of fossil species.

Beginning with the Brachiopoda, the text goes on up through the vertabrates. It then returns, begins anew with the Echinodermata, and progresses downward, ending with the protozoa. There are certain features in the classification of the vartabrates that occasion surprise, as the reduction of the birds to the position of an order among the Reptilia, below the Ornithosauria, or Pterodactyls. Another feature is the absence of the Pythonomorpha; one wonders what is to be done with the saurians that have been referred to that order.

But in spite of one or two innovations of questionable value, the book seems practical and attractive. Its style is sufficiently untechnical so as not to repel either the beginning student or the general reader. The tables of formations are of value to the person who does not wish to continually consult reference volumes. Unfortunately they apply to Europe alone, and are a trifle old-fashioned. One regrets that there is not such a book designed to fit the most modern developments of geology and paleontology in America. C. L. F.

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